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PROBING QUANTUM MANUFACTURING

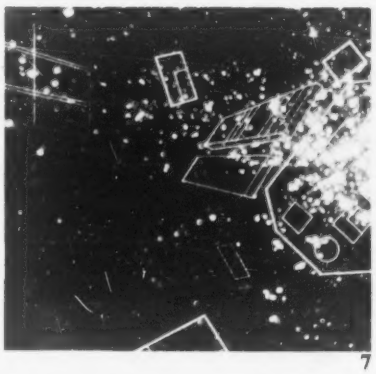
Machines That Talk Are Making Noises in the Factory

Automated Welding Trickles Down to the Small Shop

Special Technical Reports from Two Conferences

PRODUCTION

FEBRUARY 1986 COVER-TO-COVER VOL. 97 NO. 2



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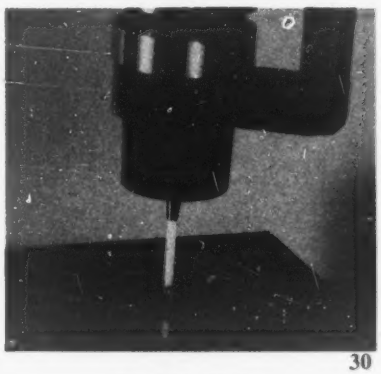

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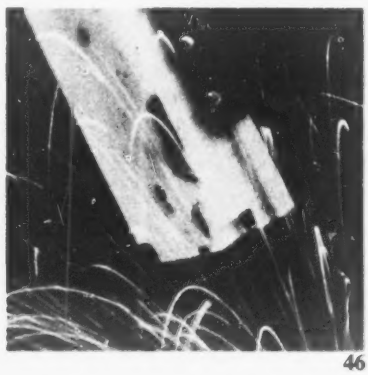

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PROBING QUALITY IN MANUFACTURING

30 *Quality Control is now viewed as a cost reduction tool, rather than the traditional acid test for product acceptability. Probes, sensors, lasers and CIM ultimately will result in higher productivity.*

VOICE TECHNOLOGY IS BEGINNING TO SPEAK UP

40 *The development of computers that can actually talk is well on its way to becoming a multibillion industry by the year 2000. The implications for business and industry will be staggering.*

AUTOMATED WELDING EQUIPMENT TRICKLES DOWN TO THE SMALL SHOP

46 *Manufacturers are now targeting high tech welding technology to the small shop, offering price, productivity, payback—and quality.*

PUSHING BACK THE FRONTIERS OF MANUFACTURING

55 *PRODUCTION Magazine spotlights recent developments and applications of new manufacturing equipment excerpted from two machine tool forums held in the United States and West Germany.*

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An Active Labor Year Seen in '86

Labor contracts covering 3.8 million workers expire or will be re-opened for negotiation this year, with major agreements to be negotiated in the construction, steel and farm machinery industries, the Bureau of Labor Statistics reports.

The total represents 41 pct of the 9.1 million U.S. workers covered under collective bargaining agreements for 1,000 employees or more.

Among the contracts open next year are agreements between the United Automobile Workers and Caterpillar Tractor and Deere & Co. Agreements between United States Steel and other major producers and the United Steelworkers of America expire in August, 1986.

By contrast, the percent of companies with expansion plans for their office/clerical and technical/professional staffs was steady, with fourth quarter and first quarter projections at 13 pct and 11 pct respectively. Projections of expansion in the office/clerical and technical/professional sectors have been fairly stable over a period of almost two years.

Layoffs remain considerably higher among production/service employees than in other employment sectors, BNA reported.

Thirty pct of the companies reported having production/service workers on layoff in October and November, up from 27 pct in July and August and five pct points higher than for the same period in 1984. The increase in production/service layoff incidence is greatest among southern and north-central organizations.

Fifteen percent of the firms responding to the survey expect reductions in their production/service workforces during the first quarter of 1986, up three percentage points from the previous quarter. The proportion of firms anticipating workforce cutbacks increased in all regions but the south.

–Ed Bowers

WASHINGTON

Machine Tool Orders Fall 19 Pct in November to $186 Million

Reflecting the continuing slump of the U.S. manufacturing industries, new orders for machine tools in November totalled just over $186 million, down 19 pct from October's order level.

According to the National Machine Tool Builders' Association (NMTBA) cumulative orders for the first 11 months of 1985 totalled $2.34 billion, a level 12 pct below the value of orders received during the same period last year.

The NMTBA reported that November machine tool shipments stood at $197 million, down 1 pct from October, and left the year-to-year total at $2.17 billion, an increase of 8 pct over the 1984 11 month total.

NMTBA President, James A. Gray, remarked that the while the overall economy is beginning to show signs of rekindled growth, the manufacturing sector is still struggling. "The continued slump in machine tool orders reflects the current status of American's manufacturing industries," Mr. Gray said. "Adding to the problem," he continued, "is concern over the fate of tax reform. As things currently stand, Congress is poised to take back the very elements that led to the capital spending boom of the early 1980s."

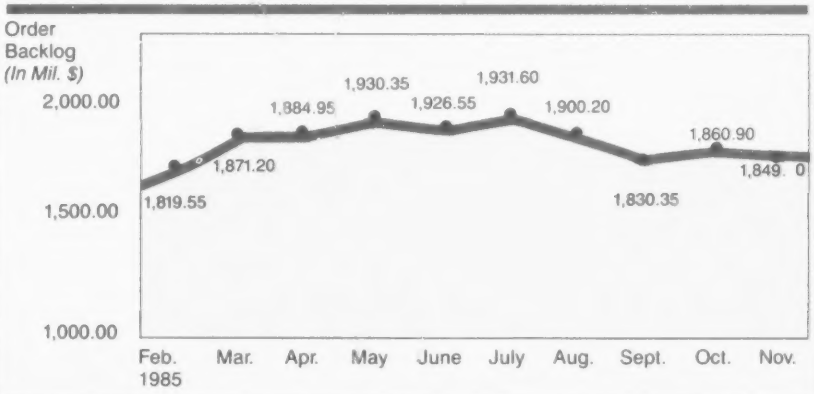
"It's not tax reform, it's tax redistribution," asserted Mr. Gray. "It's incredible that considering the United States' huge trade imbalance, the new tax bill provisions discourage investments in new equipment."

The NMTBA also reported that metalforming orders for November totalled only $14.6 million—about 80 pct below October's figures. Metalforming shipments, at $59.8 million, were down 13.9 pct from their October total. Orders for metalcutting machine tools, at $171.6 million, increased 10 pct in November, while shipments of $137.7 million were up 6 pct from October.

Machine tool order backlogs decreased in November, to $1.85 billion, from $1.86 billion in October.

–Ed Bower

MACHINE TOOL ORDERS
Backlog



tained we can get the real operating time of the systems in one month longer then 500 hours. Main causes of system breakdown come from operator's error (60 pct) and engineering mistakes (20 pct), while 15 pct of occurrence of the system breakdown comes from tool breakage in use.

Developments

There are several recent drastic progresses in the field. One is the success of the weekend operation of the systems for machining the press forming dies. The second progress is new development of the simulation program for design and operation verification of the flexible manufacturing system. The third one is real time scheduling for operation of the flexible manufacturing system. One machine tool builder has developed a special operating algorithm with which the central computer can decide the following event after finishing one operation by computing the priority of all the remained events. This gives the operation of the system high flexibility and increases utilization of every hardware component such as machine tools, tools, pallets, jigs and fixtures. The fourth progress can be seen in development of transfer type flexible manufacturing systems which can be applied to the medium lot size and medium volume production. The similar, five or six different kinds of mechanical parts are machined in sequence with the cycle time from two to five minutes in the flexible transfer line consisting of more than ten NC machine tools. Because of more frequent use, 60 pct of the system breakdown is found to come from poor design, assembling and adjustment of the machine tools and the associated mechanical devices. So it is desired that every mechanical part in the system must be more carefully designed and assembled.

Trends in CIM in the USA

Paul R. Warndorf, Cincinnati Milacron Inc.
M. Eugene Merchant, Metcut Research Associates, Inc.

The integration of data, information, and control of product, from the concepted stage through production, to shipment and support, is referred to as Computer-Integrated Manufacturing (CIM). Though no company has yet achieved total integration of its operating environment, great strides are being made in the CIM direction. To many manufacturers, this will be the operating mode of the "Factory of the Future" and is the only solution to survival for the manufacturing industry.

In recent study conducted by the CAD/CAM Interface Committee of the Manufacturing Studies Board of the National Research Council, five of the leading U.S. companies in the development of CIM were reviewed to determine the expected benefits of CIM. Those are shown in the accompanying table.

The Board also stated that the problems associated with integration today occur at three levels:

1. The ability of different programs to communicate together even on the same computer.
2. Communication problems which exist between computers even of the same brand.
3. Communication problems among a variety of manufacturers' systems.

The Board also points out the importance of continuing work on resolving these problems and the importance of standardization to CIM.

A key to the success in overcoming the above problems in the United States is through programs and investigations into common standards like the Initial Graphics Exchange Specifications (IGES), a program initiated and funded by the U.S. Air Force. Two other important U.S. programs addressing the problem of computer integration are MAP and AMRF. MAP is a proposed technical standard specification for a Manufacturing Automation Protocol in the manufacturing Local Area Network environment. It was originated by the advanced product and manufacturing staff of the General Motors Technical Center. The standard is now gaining wide support. It now involves over 100 American manufacturing companies, and will be tested by the U.S. National Bureau of Standards Automated Manufacturing Research Facility (AMRF).

AMRF, is a test facility which assists in the evaluation and development of proposed standards for integrating the various elements of the CIM system, including both the hardware and software of automated equipment and control systems.

CIM Benefits

Reduction in engineering design cost	15 – 30%
Reduction in overall lead time	30 – 60%
Increased product quality as measured by yield of acceptable product	2 – 5 Times Previous Level
Increased capability of engineers as measured by extent and depth of analysis in same or less time than previously	3 – 35 Times
Increased productivity of production operations (complete assembles)	40 – 70%
Increased productivity (operating times) of capital equipment	2 – 3 Times
Reduction of work in process	30 – 60%
Reduction of personnel costs	5 – 20%

CIM is becoming increasingly important in the U.S. as a result of the foreign competitive pressure of cost, delivery and reliability that have, in some cases, outweighed the advantages of product differentiation in the promotion of sales.

Some changes in industry's thinking are taking place and can be seen in various trends in manufacturing operations.

Trends

The first trend originates on the production shop floor. Until now, companies classified themselves as either a producer of goods to order, or a producer of goods for stock. This is the distinction between a job shop and a mass production or process type operation. As a result of the need to meet changing requirements and shorter production cycles, this distinction is being broadened to include a third classification.

Both mid-and high-volume manufacturers, to meet customer pressures, are trying to take on the appearance of suppliers of custom made products while maintaining high throughput of workpieces and optimum use of assets. This is exemplified by the incorporation of tool changing machining center modules into transfer line systems to permit flexibility for part changeovers. It is also apparent in the automotive industry which looks toward custom order manufacturing using flexible manufacturing cells and flexible manufacturing systems as the solution to the problems of short life cycle of parts and fluctuation of demands in delivering components.

A second area of trends deals with plant computer architectures for automated operations. In the factory, local area networks are being designed and used to distribute information between higher level computers and miscellaneous processing equipment. This is preferred over directly connecting the two together, because it permits the easier addition and deletion of components from the network. Micro computers are seen as the lower level controllers to interface computer numerical controls, programmable logic controllers or other control devices to the local area network system. Higher level computers are moving from 16-bit to 32-bit computers. This increases the processing capabiltiy at this higher level.

The third trend is the reevaluation of data base structures for the storing and retrieving of information. This is an important area a company must consider. It is the foundation on which CIM will be built and therefore, it must offer the flexibility to add, delete, and modify current or evolving new features and components without extensive modifications to existing structures. Because of the need for flexibility, there is a move toward relational data base structures. This also seems to be desired because it better accommodates data flow to a variety of users.

Recent Developments in Flexible Manufacturing Systems in Japan

Prof. Dr. K. Iwata, Kobe University, Kobe, Japan

The developments of FMS in Japan were realized at the beginning in the field of machining for mid-volume mid-variety production. As the systems for machining were highly developed later, the developments were expanded in four directions.

The first direction is expansion to the fields other than machining, those are manufacturing utilizing plastic forming, manufacturing of raw materials and unconventional machining, etc. The major interests at present are concentrated to developments of FMS using plastic forming, such as for sheet metal and forging.

The second is dedicated to development of small size or compact FMS which is generally called FMC (Flexible Manufacturing Cell). As regards

Examples of Flexible Assembly Systems developed in 1983

Company where system is installed	Kinds of products	Outline of System		Year of start of operation
		Assembly equipment	Equipment of transportation	
Takasaki Plant of Oki Electric Co.	Chinese character printer 3 types, 143 kinds, number of parts 219, 2000/month	Assembly robot 49, (6 axis robot 21, 4 axis robot 28) special purpose unit 21	Automatic cart 4, free flow conveyor	Nov. 1983
Richo Co.	Developing machine 4 kinds	6 axis robot 7	Motorized conveyor, unattached cart and forklift are used partially	Spring 1984
Awazu Plant of Komatsu Ltd.	Parts of construction machinery, mainly arm and frame etc. about 30 kinds	Arc welding robot 7 (rectangular type), versatile stocker 10, complex NC machine 1	Guided unattached cart 3	March 1984
Kaji Plant of Mitsubishi Electric Co.	Electromagnetic switch, 7 kinds number of parts about 30	Assembly robot 4, (4 axis) automatic product inspection machine 1	Free flow conveyor	Oct. 1983
Okazaki plant of Toyoda Machine Works Co.	Vane pump for automobile power steering 24 kinds, number of parts 35	Assembly robot 15 (5 types), measurement, inspection	Linear motor	April 1983
	Flow control valve 6 kinds	Assembly center (assembly robot 3, base frame)	Robot	April 1983